State feedback controller tuning for liquid slosh suppression system utilizing LQR-LMI approach

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ABSTRACT

This paper presents a tuning constraint optimization approach in state feedback controller for liquid slosh suppression system. A suboptimal LQR method is employed to obtain the optimal gain parameters in minimizing the selected cost function. Due to complexity of the nonlinear slosh system, a partial linearization method was first performed to obtain its linear state space representation. Due to the presence of the large steady-state error caused by the implementation of only the state feedback gains, an additional integral term has also been introduced to mitigate its effects. A comparative assessment on the system performance is investigated between regular LQR and LQR-LMI control algorithms. The presented results indicated that the LQR-LMI exhibited better transient response performance as compared to the regular LQR for the case of moving the cart to its intended final position while ensuring the slosh motion is suppressed to a minimum angle.

KEYWORDS

Slosh suppression; State feedback controller; Integral action; Suboptimal LQR; Linear Matrix Inequality (LMI)

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